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THE IMMATURE STAGES OF *TENDIPES (TENDIPES) CRASSICAUDATUS* (MALLOCH) (Tendipedidae: Diptera) WITH NOTES ON LIFE HISTORY AND ECOLOGY

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and
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Malloch (1915) described the adult male and female of *Tendipes crassicaudatus* (as *Chironomus crassicaudatus*) from specimens collected in Peoria, Illinois and Lakes Lomalta and Kathrine, Texas. Richardson (1921) briefly described the occurrence of this species in the Illinois River. Townes (1945, 1952) redescribed the adult stages and noted the following geographic distribution: Illinois, Iowa, Kansas, Maryland, Michigan, Minnesota, Nebraska, New Jersey, Oklahoma, Ontario, Pennsylvania, and Texas. His specimens were collected from April 30 to September 13.

The material upon which the present descriptions are based was collected from Red River at Grand Ecore, Natchitoches Parish, Louisiana, and the farm ponds of the Agricultural Experiment Station at Auburn, Alabama. In all, eight mature larvae were successfully reared to the adult stage and four to the pupal stage. Adults captured at Auburn were bred in one-quart containers, containing about one inch of filtered pond water. Adults collected June 27, 1956, had produced egg masses by the following day. By June 29 almost all the eggs had hatched. Some of the larvae were killed in the first instar when less than a day old and preserved. Only one larva was reared to any size. It died and was preserved on July 6.

EGG. Mature eggs in clusters were light green in color, measuring a mean of 0.35×0.104 mm. First instar larvae shortly after hatching measured 0.9 mm over all, with the head being 0.14 mm long. Ventral "gills" are absent from the nearly colorless first instar larvae, agreeing closely with Sadler's (1935) finding for *Tendipes tentans* (Fabricius).

MATURE LARVA. Color, blood red as is typical of most members of *Tendipes (Tendipes)*. Mean head length, 0.84 mm; mean body length, 18.0 mm. Lateral margin of the tenth segment bears a short gill-like extension which is one-sixth the diameter of the segment. Ventral surface of the eleventh segment bears two pairs of long "blood gills" which are 1.3 times the segment diameter. Head, light brown except gular and occipital regions, and tips of mandibles which are black. Vertically paired eyespots

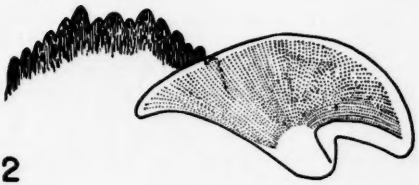
[1] Subsidized by a National Institutes of Health grant, RG4594, for the study of the distribution of Tendipedidae in relation to domestic sewage pollution.

very small, rounded, and separated by a distance of two times the diameter. Antennae, short (0.18 mm. long) with a segment ratio of 110:26:9:11:7 (fig. 1); ring organ located near the middle of the basal segment and 0.26 times the diameter of the segment. Labial plate with thirteen darkened teeth; the middle one broadly trilobed as in other typical members of the subgenus (fig. 2). Paralabial plate medially reaching a point in line with the first lateral tooth of the labial plate; paralabial plate with numerous very weak striations. Ventral surface of labrum and epipharyngeal apparatus as in fig. 3. There is considerable variation in size and arrangement of teeth on the epipharyngeal plate; however, the two larger teeth on either side of the central group of 5-6 teeth seem to be consistently present. Also, the remaining teeth show an irregularity in length not seen in other members of the genus. Mandible (fig. 4) strongly hooked; the tip and two distal teeth, blackened; basal tooth pale, as is remainder of mandible; accessory tooth very small and obscure; preapical comb has about fifteen elements; mandibular brush composed of four branching parts, the two proximal ones being basally fused. Maxilla (fig. 5) with numerous sensory bristles which differ little from other *Tendipes (Tendipes)*. Posterior prolegs short and broad; each bears about sixteen yellowish brown claws. Preapical papillae about as long as high and each bears about 6 short terminal bristles and one very short bristle on the anterior face. Two pairs of anal "gills" about 4 times as long as wide and slightly over one-half as long as the posterior prolegs.

PUPA. Length, 11 mm. Color, reddish brown to brown. Respiratory organ composed of numerous filaments. Abdominal tergites covered with a variable amount of fine shagreen, incomplete on segments 1 and 7, almost completely covering tergites 2-6 and 8; posterior margin of second tergite with a row of about 120 darkened upturned hooks. Posterio-lateral spur of segment 8 has from 14 to 16 darkened, coalesced spines. Lateral margin of segment 8 with 5 lateral flattened filaments; segments 5-7, 4 filaments; and segments 3-4 with 3 lateral bristles. Swim fin with about 110 filaments. Cephalic tubercles slightly darkened, curved, acutely tipped; each bears a small subapical bristle.

ADULTS. Specimens collected in both Louisiana and Alabama agreed with Townes' (1945) description differing only as follows: mean leg ratio for males 1.25, with a range of 1.11-1.35. Mean wing length for males 4.64 mm., with a range of 3.77-5.4 mm. Female, mean leg ratio 1.3, range 1.26-1.33; mean wing length 5.37 mm., range 5.25-5.62 mm. Ground color, pale brown to light green. First abdominal tergite with indefinite brown band; second to fourth tergites with distinct transverse brownish black bands which lie mostly in anterior half of each tergite; fifth to seventh tergites with slightly more than anterior half blackish brown; remaining tergites completely blackish brown. Sternites 1-4 same as ground color; remaining, blackish brown.

A good field recognition characteristic for the adult male of this species serving to separate it from other species of the genus that superficially resemble it in size and color is to be found in the abdomen which tapers posteriorly then abruptly enlarges to the massive genital capsule.



EXPLANATION OF PLATE

Larval structures of *Tendipes crassicaudatus* (Malloch). Figure 1. Antenna. Figure 2. Labial and left paralabial plate. Figure 3. Ventral surface of labrum and epipharyngeal apparatus. Figure 4. Mandible. Figure 5. Maxilla.

ECOLOGY. This species demonstrates a considerable range of habitat preference. It has been collected from large rivers (Red River, Illinois River), farm ponds (Auburn, Alabama) and a river lake (Cane River Lake, Natchitoches, Louisiana). It shows, however, a consistent substratum preference of soft sandy silt to silty sand bottom, with varying admixtures of organic matter. In Red River these substrata occur principally in large, deep, rather quiet pools. The maximum depth encountered was 5½ meters at which large numbers of *Tendipes crassicaudatus* occurred almost in a pure community. In shallower water with greater admixtures of sand *Tendipes crassicaudatus* diminished in numbers with an increasing occurrence of other species shoreward. This is in agreement with Richardson's (1921) findings in Lower Peoria Lake (Illinois River) where he observed that adults emerged from the channel and four- to seven-foot zone but not from the one- to three-foot zone.

At this latitude *Tendipes crassicaudatus* has been observed to emerge during most of the months of the year. However, during the winter and spring months the emergences are restricted to isolated individuals with no apparent swarm formation. On Red River, the largest swarms do not occur until late summer and early fall, coinciding with the periods of low water level. The last large swarm observed at Natchitoches was November 3.

The larva keys to *Chironomus hyperboreus* [=*T. anthracinus* (Zett.)] in couplet 42, p. 23 of Johannsen (1937). It can be differentiated from *T. anthracinus* by the position of the ring organ on the antenna and structures of the epipharyngeal apparatus.

The pupa keys to couplet 38, p. 26 of Johannsen (1937). It differs from *T. plumosus* and *T. tentans* in having a larger number of fused spines in the spur of segment 8 and in the presence of the row of darkened hooks on the posterior margin of the second abdominal tergite.

This report represents the first record of occurrence of this species in Louisiana and Alabama.

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TWO NEW GERRIDS FROM THE PHILIPPINES (Hemiptera, Gerridae)

H. B. HUNGERFORD[1]

In 1933 Dr. O. Lundblad described *Potamometropsis obnubila* new genus, new species, from Sumatra. (Archiv. f. Hydrobiologie Suppl. Bd. XII Tropische Binnengewässer IV., pp. 415-417.) His description was based upon a single female but I have a male from Sumatra which Dr. Lundblad has examined and says is his species. This specimen has lost its legs but its body is more hirsute than the species I am describing below. The right clasper is smooth, shining and not hirsute and the genital capsule is truncate at its tip as shown on Plate I. The two new species I have before me may be assigned to the same genus. They come from the Philippines.

Potamometropsis hoogstraali n. sp.

Size: Male apterous holotype: length 8.2 mm.; width across mesoacetabula 2.56 mm.; width across head 1.43 mm. Female apterous allotype: length 8.82 mm.; width across mesoacetabula 3.27 mm.; width across head 1.43 mm.

Color: Black trimmed with yellowish brown above, yellowish brown on the venter, all beneath a silvery pile. Antennae dark brown, front femur yellowish brown with two longitudinal black bands dorsally, front tibia blackish brown dorsally, lighter beneath; other legs dark above and lighter beneath; propleuron yellowish brown, mesopleuron before the acetabulum black with a longitudinal narrow undulate silvery band. The black and tan pattern of a dealated male and of an apterous female are shown on plate II. (The wing bases are actually smoky black but shown lighter in the illustration.) The mesonotum of apterous individuals may have two yellowish brown spots separated by a black band or a single elongate stellate light figure.

Structural Characteristics: Male—Relative length of antennal segments: 1st:2nd:3rd:4th::170:55:73:47. Total antennal length to body length:: 7.14 mm.:8.2 mm. Beak short, stout, barely reaching anterior margin of mesosternum.

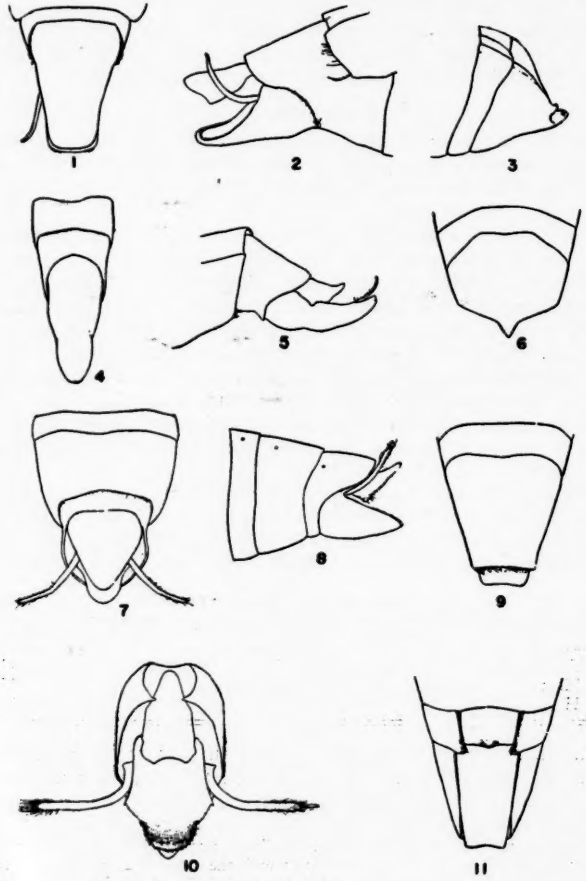
The Relative Length of the Leg Segments

	Femur	Tibia	Tarsal seg. 1	Tarsal seg. 2
Front leg	220	180	63	40
Middle leg	550	263	131	28
Hind leg	540	220	5	11

Antennae stout, first segment not quite as long as the other three together; last segment slightly curved. Front legs stout; the diameter of the femur 32 spaces compared with its length of 210 spaces; the diameter of the

[1] Contribution No. 963, Department of Entomology, University of Kansas. This report is a by-product of a project conducted with the aid of a grant from the National Science Foundation. Illustrations for this paper were made by Dr. Ryuichi Matsuda.

tibia 12 spaces which is about the same as that of the femur of the middle leg; femur and tibia straight, the latter with a lateral projection before its tip; first tarsal segment strikingly longer than the second; claws antiapical, curved. Middle femur a little stouter than hind femur, its tibia with a band of procumbent dark hairs its entire length. Connexivum more or less vertical. In the female, the rear angle of the sixth connexival segment produced and recurved, the sixth dorsal abdominal segment with a tubercle on its rear margin and the last abdominal segment longer than the three preceding. In the male the last dorsal abdominal segment as long as the



two preceding and a little longer than the first genital segment. The exposed and conspicuously hairy claspers are characteristic.

Comparative notes: Separated from *Potamometropsis obnubila* Lundb. by its larger size, more shining body, by the very different connexivum in the female, by its relatively larger first genital segment in the male and by the more pointed genital capsule. The two winged forms before me, a male and a female, have removed their wings leaving only the stumps.

Location of types: This species is described from the following specimens:

From La Lun Mts., Davao, Mindanao, Philippine Is., C. S. Clagg, June 6, one male, one female (deälated).

Sibulan Riv., 7-8000 ft., Sept. 6, Mt. Apo, Mindanao, Philippine Is., C. S. Clagg, two females (apterous), one nymph. Mainit Riv., 6000 ft., Sept. 4, Mt. Apo, Mindanao, Philippine Is., C. S. Clagg, one nymph.

C. N. H. M. Philippine Zool. Exped. 1946-47, Aug. 22, 1946, H. Hoogstraal. E. slope Mt. McKinley, Davao Prov., Mindanao, Philippine Is., forest stream, two males, two females (apterous).

C. N. H. M. Philippine Zool. Exped. 1946-47, H. Hoogstraal leg., E. slope, Mt. McKinley, Davao Province, Mindanao, stream through original forest, elev. 3000 ft., 1946, three males, five females, two nymphs.

C. N. H. M. Philippine Zool. Exped. (1946-47), H. Hoogstraal leg., Mainit, E. slope, Mt. Apo, Davao Province, Mindanao, 4300 feet, Oct., 1946, stream through original forest, two females.

Those collected by Clagg are from the Museum of Comparative Zoology, Harvard. Those collected by Hoogstraal from the Chicago Natural History Museum.

The holotype males and allotype female are in the Chicago Natural History Museum. Paratypes in the Museum of Comparative Zoology at Harvard and the Francis Huntington Snow Museum, University of Kansas.

Potamometropsis werneri n. sp.

Size: Apterous male, length 6.7 mm. to 7.35 mm.; width across mesoacetabula 2.1 mm.; width across head 1.14 mm.-1.21 mm. Apterous female, length 7.14 mm. to 7.56 mm.; width across mesoacetabula 2.52 mm. to 2.77 mm.; width across head 1.22 mm. to 1.36 mm.

PLATE I

Fig. 1. *Potamometropsis obnubila* Lundb. Male genital segments, ventral view. Note the truncate tip of the ninth segment (genital capsule); other clasper withdrawn out of sight. Fig. 2. *Potamometropsis obnubila* Lundb. Male genital segments, right side view. Fig. 3. *Potamometropsis werneri* n. sp. Female terminal abdominal segments, left side view. Genital segments withdrawn. Fig. 4. *Potamometropsis werneri* n. sp. Male genital segments, ventral view. Fig. 5. *Potamometropsis werneri* n. sp. Male genital segments, left side view, showing the protruding left clasper. Fig. 6. *Potamometropsis werneri* n. sp. Female terminal abdominal segments, ventral view. Fig. 7. *Potamometropsis hoogstraali* n. sp. Male genital segments, ventral view. Fig. 8. *Potamometropsis hoogstraali* n. sp. Male genital segments, left side view. Fig. 9. *Potamometropsis hoogstraali* n. sp. Female terminal abdominal segments, ventral view. Fig. 10. *Potamometropsis hoogstraali* n. sp. Male genital segment (genital capsule) or ninth segment with suranal plate relaxed and moved caudad (more enlarged than figure 7). Fig. 11. *Potamometropsis hoogstraali* n. sp. Female abdominal tip, dorsal view, showing the sixth connexival segment, produced and turned in, and the tubercle on the sixth segment.

Color: Black above with a crescent-shaped spot on the base of the head, an arrow-shaped median stripe on the pronotum, the coxae and trochanters, yellowish brown; the venter pale yellowish brown except the anterior half of the mesosternum which is black, except sometimes medianly, all beneath a silvery pile. Antennae dark brown; front femur yellowish brown with one longitudinal broad black band dorsally; front tibia blackish brown dorsally; other legs dark above, somewhat lighter beneath; propleuron pale yellowish brown with the black of the pronotum extending to the base of

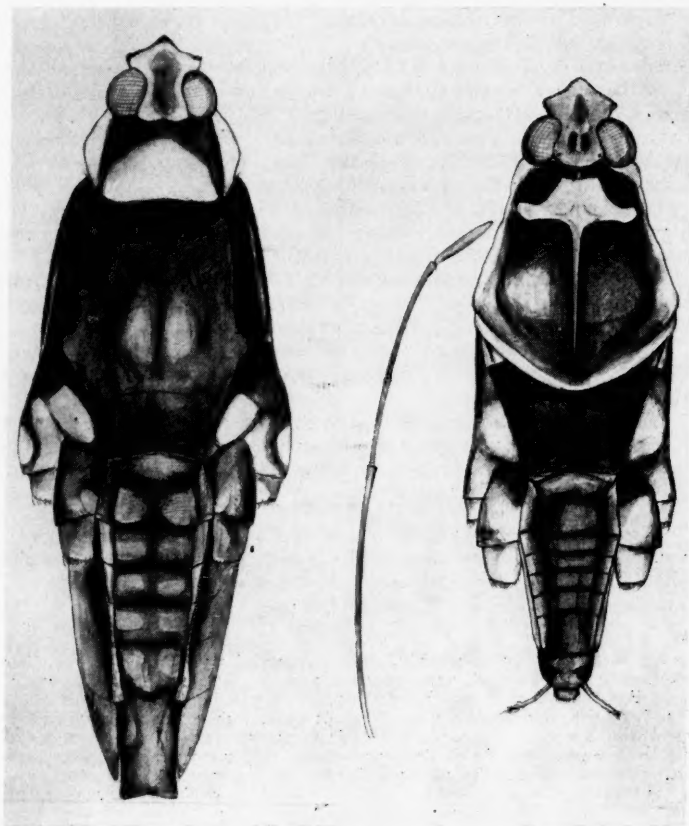


PLATE II

Potamometropsis hoogstraali n. sp. Left, apterous female. Right, deälated male showing only the wing stumps behind the enlarged pronotum. Center, antenna of the male (with the terminal segment at the top in such a position that it does not show its curvature).

the acetabulum medianly; the mesopleuron black except the acetabulum, with a longitudinal undulate silver band; the meta-acetabulum black with a pale spot covered by silvery hairs.

Structural Characteristics: Male—Relative length of antennal segments: 1st:2nd:3rd:4th:: 150:58:66:40; total antennal length to body length:: 6.6 mm.:7.35 mm. Beak short, stout, not touching anterior margin of mesosternum.

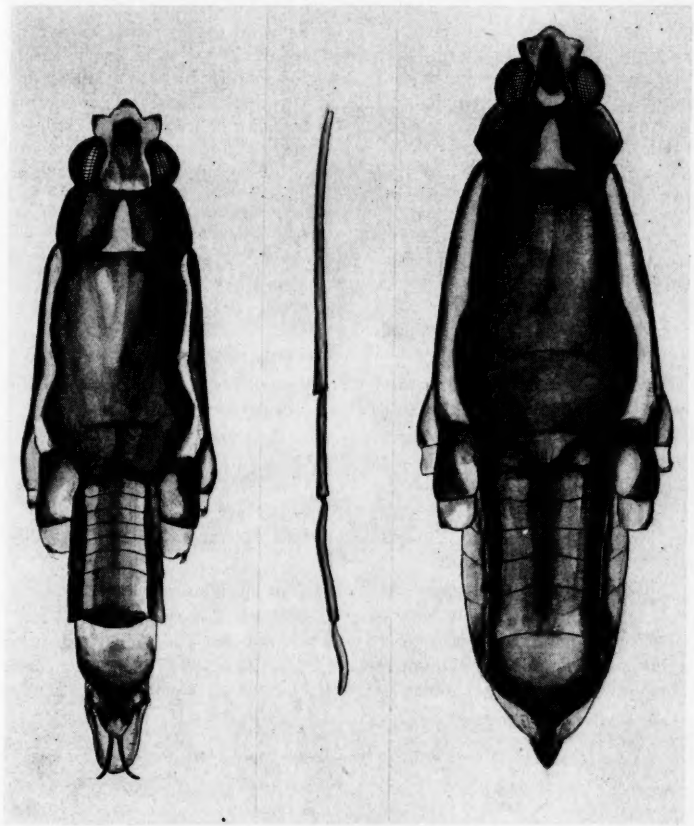


PLATE III

Potamometropsis werneri n. sp. Left, apterous male. Right, apterous female showing the first abdominal tergite with its anterior margin indistinct and the procumbent protuberance on its surface. Center, antenna (with basal segment at the top and showing the characteristic curvature of the terminal segment).

Antennae stout, first segment not as long as the other three together; last segment somewhat curved. Front legs moderately stout; the diameter of the femur 22 spaces compared with its length of 180 spaces; the diameter of the tibia 11 spaces which is about the same as that of the femur of the middle leg; femur and tibia straight, the latter with a lateral projection before its tip; first tarsal segment strikingly longer than the second; claws antiapical, curved. Middle femur a little stouter than the hind femur, its tibia with a band of procumbent dark hairs its entire length. The connexivum may be flat or vertical and in the female almost disappears laterally on the last abdominal segment to embrace its caudally, exposing its ventral side; the last abdominal tergite of the female large, very broad. In the female the first abdominal tergite with its anterior margin indistinct and a procumbent protuberance on its surface. In the male, last dorsal abdominal segment longer than the preceding four but shorter than first genital segment; genital capsule constricted across caudal third and claspers hairy, strongly curved upward and fairly sharp. Rear margin of middle femur of males with one or two rows of short spines.

The Relative Length of the Leg Segments

	Femur	Tibia	Tarsal seg. 1	Tarsal seg. 2
Front leg	180	140	47	25
Middle leg	495	234	97	27
Hind leg	503	112	8.5	14

Comparative notes: This species is in some respects closer to *Potamometropsis obnubila* Lundb. than to *P. hoogstraali*. See the key below.

Location of types: This species is described from the following specimens: "Barungkot, Upi, Cotabato Province, Mindanao, 1500 ft., C. N. H. M. Philippine Zool. Exped. (1946-47), T. G. Werner leg., stream through original forest." Two males, three females and three nymphs.

"Mt. Apo, Mindanao, Philippine Islds, C. F. Clagg, Sibulan Riv., 2000 ft., Oct. 8." Two females.

Those taken by Werner belong to the Chicago Natural History Museum and those by Clagg to the Museum of Comparative Zoology, Harvard.

Holotype, allotype and a paratype in Chicago Natural History Museum, other paratypes in the Museum of Comparative Zoology at Harvard and the Frances Huntington Snow Museum, University of Kansas.

Key to Species of *Potamometropsis*

A. Front femur with two longitudinal black bands on dorso-caudal side ..... *P. hoogstraali* n. sp.

AA. Front femur with one longitudinal black band on dorso-caudal side.

B. Male with genital capsule truncate at tip and not constricted. Female with two connexival segments broadly expanded and recurved over abdomen ..... *P. obnubila* Lundb.

BB. Male with genital capsule roundly pointed and constricted. Female connexivum not as above ..... *P. werneri* n. sp.

ANTHIDIINAE, MAINLY FROM KANSAS AND TEXAS (Hymenoptera: Megachilidae)

HERBERT F. SCHWARZ
American Museum of Natural History, New York City

The present paper is based chiefly on specimens of Anthidiinae in the American Museum of Natural History and in Kansas State College at Manhattan, Kansas. I am indebted to Mr. Roland L. Fischer for the specimens made available from the latter institution. In the main the material discussed was collected in the Middle West, for the most part in Kansas and Texas.

Anthidium psoraleae Robertson

This species was described from Carlinville, Illinois (Robertson, 1902, Canadian Ent. 34:322) and was subsequently reported from Nebraska (Swenk, 1914, Univ. Studies, Univ. Nebraska, vol. 14, p. 12). So far as I am aware, *psoraleae* has not previously been reported from Kansas. Before me are two females, both collected at Manhattan, Kansas, by C. W. Sabrosky, the one on June 8, 1932, the other on June 4, 1933.

Usually the terminal abdominal segment of the male is characteristically shaped in the Anthidiinae, but in the female, too, the terminal segment in some species, at least, is of rather individual contour, as evidenced in the accompanying drawing of *psoraleae* and of two other females—*clypeodentatum* and *banningense*.

EXPLANATION OF FIGURES

Last two segments of the abdomen in dorsal view of the female of A. *Anthidium clypeodentatus* Swenk; B. *Anthidium psoraleae* Robertson; C. *Anthidium banningense* Cockerell. Drawings by Alice Gray.

Anthidium porterae Cockerell

This species, originally described from New Mexico (Cockerell, 1900, Ann. Mag. Nat. Hist. (ser. 7) 7:411) has been reported also from Colorado Utah, Texas, Wyoming, Montana, Kansas and Nebraska (Schwarz, 1927, Amer. Mus. Novitates, no. 253, p. 11). I have likewise seen a male specimen from Arizona. It was collected at Flagstaff, August 18, 1934, by F. E. Lutz and is assignable to the variety *amabile*. Recently, too, I have had occasion to examine a small series of *porterae* from Santa Clara in the Mexican State of Chihuahua, which were collected on July 2, 1947 by W. J. Gertsch, and a male specimen of *porterae* variety *amabile* obtained by H. Spieth at Encino in the Mexican State of Durango on July 27, 1947.

As Swenk has pointed out (1914, Univ. Studies, Univ. Nebraska, 14:13), *porterae* was confused with *maculifrons* Smith by Hungerford and Williams (1912, Ent. News 23:256) and their comments on *"maculifrons"* therefore apply to *porterae*. Their specimens were from five counties in Kansas: Wallace, Cheyenne, Rawlins, Wichita, and Grove. To these Kansas records can be added Comanche County from which there are before me two females collected on July 15. A small series from Wallace County, containing both sexes, were collected July 11. Some of the males are typical *porterae,* others bear the earmarks of what Cockerell has described as *porterae* variety *amabile.*

Anthidium maculosum Cresson

A female of *maculosum* secured by C. D. Michener ten miles southwest of Pharr, Texas, March 31, 1946, adds yet another state to the extensive distribution records of this species, which, described on the basis of specimens from Utah and California (Cresson, 1878, Trans. Amer. Ent. Soc. 7:110), is known to occur, likewise, in the following Far Western states: New Mexico, Colorado, Arizona, and Oregon (Schwarz, 1927, Amer. Mus. Novitates, no. 253, p. 3). In the Middle West the species has been reported from South Dakota (Swenk, 1914, Univ. Studies, Univ. Nebraska, 14:21). *Anthidium maculosum* extends even into Mexico, where it has been reported from Atzcapolzalca (Schwarz, 1928, Jour. New York Ent. Soc. 36:372). Atzcapolzalco is a locality near Mexico City, and the occurrence there of *maculosum* indicates that the latitudinal range of this species is not less impressive than its longitudinal extent.

Anthidium palmarum Cockerell and
Anthidium palmarum micheneri, new race

It is somewhat surprising to find this species occurring in Quemado, Texas, where it was collected by C. D. Michener on lupine, March 28, 1946. Presumably Quemado is the locality on the Rio Grande in Maverick County near the southern end of Texas, and not far from Eagle Pass.

All of the previous records of *palmarum* have been from California and Nevada. The type material consisted of a specimen each from Palm Springs in Riverside County and Los Angeles in Los Angeles County (Cockerell, 1904, Bull. Southern California Acad. Sci. 3:59-60). Other specimens have been recorded from San Diego County (Schwarz, 1927, Amer. Mus. Novitates, no. 253, pp. 1-3) and there is before me also a small series (five specimens) from Inyo County, likewise in California. Two of the specimens—a female and a male—were obtained at Westgard Pass in this county on May 26, 1937 and on May 27, 1937 respectively. The name of N. W. Frazier is associated as collector with one of the specimens. The remaining three specimens—two females and a male—come from Mazourka Canyon in the Inyo Mountains and were collected by C. D. Michener and N. W. Frazier between May 24 and May 26, 1937. Other localities which I have recorded (Schwarz, 1928, Jour. New York Ent. Soc. 36:383) include Riverside in Riverside County, the environment of Olancha, which is another site in Inyo County, and the Mohave Desert in San Bernardino County.

Nearly all of the counties cited in the previous paragraph are in the extreme southern part of California. Even Inyo, the most northern of the group, is distinctly within the southern half of the state. However, the typical form of *palmarum* extends into Clark County, which is the county across the border in Nevada. There a male was collected in Lee Canyon, Mt. Charleston, May 24, 1940 by M. Cazier, W. Reeves and P. C. Ting.

This rather compact distribution of *palmarum* makes its appearance on the Mexican border in southern Texas rather unexpected. Possibly more persistent collecting in parts of Arizona and New Mexico as well as in Mexico itself may establish a scattered continuity of distribution also in these areas.

The specimens of *palmarum* from Quemado are almost identical with those from southern California but, in view of the great distance between the two areas of known occurrence, one is tempted to give value even to the small differences that seem to separate the representatives of one area from the representatives of the other area. On the basis of these differences I am designating the specimens from Quemado, consisting of eight males and two females, as *Anthidium palmarum micheneri.*

One of the characters of the male of typical *palmarum* unusual in *Anthidium* is the presence of only "very small lateral face marks (separated from orbital margin)." In most males of *Anthidium* the entire space between the lateral border of the clypeus and the inner border of the eye is yellow, so that, if the clypeus itself be included, there is one continuous area of yellow on the lower half of the face to the level of the base of the clypeus. So constant did this rather unusual limitation of the maculation of the face in *palmarum* seem to me that I relied upon it in the key that I drew up for North American *Anthidium* (Schwarz, 1927, Amer. Mus. Novitates, no. 253, p. 10). But this character does not apply to the eight males of *micheneri,* in each of which the lateral face marks fill completely the space between the clypeus and the inner margin of the eye. In their other maculations the specimens of *micheneri* conform rather closely with those of typical *palmarum* although in the maculation of the pygidium there is considerable individual variation in *micheneri,* ranging from a clearly maculated condition of this segment to a total absence of maculation in the area. What supplements the differences noted in respect to the facial maculations of typical *palmarum* on the one hand and of *micheneri* on the other is the notable contrast in the size of these bees. Cockerell in his description of the male of *palmarum* assigned it a length of 9 mm. The specimens of typical *palmarum* before me are small in stature and 9 mm. would seem a probable maximum. However, only one of the specimens of *micheneri* has a length as low as 9 mm. and that specimen by its substantial thoracic width indicates that it belongs to the larger race. The males of *micheneri* range from about 9 mm. to about 11 mm. and their thoracic width ranges from 3.5 to 4.5 mm.

In the key to females of North American *Anthidium* I indicated that, although the clypeus of *palmarum* bore two large spots, the sides of the face had no trace or at most a speck-like trace of maculation. Since that key was issued (Schwarz, 1927, Amer. Mus. Novitates, no. 253, p. 13) I have

come upon specimens from California that have at least incipient side-facial maculations, thus nullifying what might seem a distinction between the Texas insects *(micheneri)*, which also have side-facial maculations of limited extent, and the majority of the female specimens from California in which side-facial maculations are lacking. Again the main reliance in separating the Quemado females from their very close relatives in California is that of size. The females of *micheneri* have a length of about 9 mm. and a thoracic width of about 4 mm. to 4.25 mm., while females of *palmarum* from California before me measure about 7.5 mm. in length with a thoracic width of about 3.25 to 3.50 mm.

Dianthidium sayi Cockerell

A large series of *Dianthidium sayi* from Kansas is before me. The specimens, consisting of males and females, were all collected on August 11, 1949 by Roland Fischer in Finney County, which is in the western part of the state. There is also a specimen from Morland, Kansas, collected September 13 (year not indicated) by Lantz. Morland is in Graham County, likewise in the western part of the state. This species was also reported from Sherman County and from Thomas County, which adjoin each other in the northwestern part of Kansas (Hungerford and Williams, 1912, Ent. News 23:257). These authors interpreted *sayi* erroneously as *Dianthidium curvatum* Smith (Swenk, 1914, Univ. Studies, Univ. Nebraska, 14:26). The records which Swenk supplied from Nebraska were mainly from the northwestern part of that state but he had specimens also from Rock County in the north central region of Nebraska. The species was first reported from Missouri (Say, 1824, Long's Expedition, 2:351), which according to present records is its farthest extension eastward. Say gave it the preempted name of *interrupta*. Westward *sayi* extends, according to the published records, to Texas, Colorado, Wyoming, Utah and Arizona (Schwarz, 1926, Amer. Mus. Novitates, no. 226, p. 4).

Dianthidium cressoni (Dalla Torre)

This rather conspicuously colored bee has hitherto been reported from Colorado and from Utah (Schwarz, 1926, Amer. Mus. Novitates, no. 226, p. 14). In its range may now be included also Arizona. A male specimen was collected at Flagstaff, July 17, 1930, by T. F. Winburn and R. H. Painter.

Dianthidium implicatum Timberlake

This species was erected by Timberlake (1948, Jour. New York Ent. Soc. 56:150-151) on the basis of two female specimens, one (the holotype) from San Bernardino County, California, the other (a paratype) from El Paso, Texas. Yet another specimen from Texas is before me, namely, a female secured by M. Cazier on June 16, 1948, at Hot Springs in Big Bend National Park, Brewster County. With El Paso on the border of the State of Chihuahua and Brewster County contiguous to the State of Coahuila it comes as no surprise to find that the range of *implicatum* includes also these two Mexican states. In Chihuahua several specimens, male and female, were collected by C. D. Michener, July 13, 1947, on *Cevallia sinuata*. In Coahuila

a specimen was obtained by M. Cazier at La Gloria, which lies south of Monclova.

Dianthidium concinnum (Cresson)

This species, originally described from Texas (Cresson, 1872, Trans. Amer. Ent. Soc. 4:270) and also subsequently reported from that state, has been known likewise for some time from Kansas, having been recorded from Sheridan, Cheyenne, and Greeley counties while nests were found in the first two of these counties and also in Lane County (Hungerford and Williams, 1912, Ent. News 23:256). Hungerford and Williams also reported the species from Oklahoma. Before me is a specimen of *concinnum* from Sheridan, Kansas, collected August 28, 1941. As Hungerford and Williams put a question mark after their records of *concinnum*, thereby indicating a measure of doubt regarding their interpretation of the species, it seems appropriate here to record that what I interpret as *concinnum* came from one of the localities that they listed for this species.

Dianthidium simile (Cresson)

To the single record from the State of Michigan (Douglas Lake) that was reported more than two decades ago (Schwarz, 1926, Amer. Mus. Novitates, no. 226, p. 9) can now be added three more localities from that state, namely: Manistee, July 24, 1940; Grayling, August 7, 1940; Atlanta, June 30, 1941 and July 7, 1941. Originally described on the basis of specimens from Massachusetts and Connecticut (Cresson, 1864, Proc. Ent. Soc. Philadelphia 2:378-379), this species is known to occur also in New Jersey and in Maine (Schwarz, 1926, Amer. Mus. Novitates, no. 226, p. 9). It has also been reported from the Province of Ontario, Canada (Evans, 1896, Canadian Ent. 28:13) and from Texas (Cockerell, 1911, Bull. Amer. Mus. Nat. Hist. 30:248).

Heteranthidium zebratum variety *chippewaense* Graenicher

There are before me two specimens, a male and a female from Pine County, Minnesota, where they were collected respectively August 21, 1938, and August 25, 1938, by H. E. Milliron. It is from this county that the type and allotype of *chippewaense* were derived. Although the present specimens do not agree in all respects with the description of *chippewaense*, there seems little purpose in describing them as distinct. Both the male and the female from Pine County completely lack maculations on the mesonotum, and the male also lacks maculations on the tegulae, axillae, and scutellum. The tibial maculations of the male are reduced to basal and apical spots without connecting stripes and the femora of this specimen are devoid of stripes with the exception of the first femora on the under side. The metatarsi, however, are maculated.

The female has only a small spot at the base of each tibia, without other evidence of maculation on the leg. There is no interruption of the band on tergite 1 in either of the specimens before me in contrast to the condition indicated for the male holotype and one of the females in Graenicher's description of *chippewaense*. There is feeble evidence of lateral emargination above in the bands of tergites 1 to 3 of the male before me, which is an approximation at least to the condition indicated for the male of *chippewaense*:

"a distinct emargination anteriorly on each side of band 1 to 4." The pygidium of the male under discussion is wholly black.

Anthidiellum boreale Robertson

Anthidiellum boreale was described by Robertson in 1902 from Carlinville, Illinois on the basis of the male (Robertson, 1902, Canadian Ent. 34:323). Twelve years later Swenk described the female of *boreale* from Sioux County, Nebraska, with records also from Knox County in that state (Swenk, 1914, Univ. Studies, Univ. Nebraska 14:33). Before me is a female specimen from Onaga, which is situated in Pottawatomie County in the northeastern part of Kansas. This specimen accords with Swenk's interpretation of the female of *boreale* and thus extends the known distribution of this bee to yet another state. The specimen from Onaga emerged early in July, 1925 (before the seventh or eighth day of the month) from a resinous cell that the collector, Crevecourt, detached from a pear tree in the early spring of that year.

Anthidium boreale would seem to be exceedingly close to *Anthidiellum gilense* (Cockerell), which was described on the basis of a female from the West Fork of the Gila River in New Mexico (Cockerell, 1897, Canadian Ent. 29:222). In contrast to the female of *boreale,* the clypeus of which is "wholly black," the corresponding sex of *Anthidiellum gilense* has a "small spot on each side of the clypeus." Furthermore the apical tergite of the abdomen of the female of *gilense* is black in contrast to the condition of tergite 6 of the female of *boreale,* which has "two yellow spots." A female specimen collected by F. H. Snow in southern Arizona in August, 1902, conforms with Cockerell's description of *gilense* and extends the range of that bee to another state. In its immaculate clypeus the female of *boreale* resembles the corresponding sex of *robertsoni,* but both *boreale* and *gilense* tend to differentiate themselves from *robertsoni* through their ferruginous to yellowish tibiae, these joints being black maculated with yellow in the female of *robertsoni.* On the other hand, the two-spotted clypeus of *gilense* and its wholly black tergite 6 give it a resemblance to the female of *notatum,* another close relative.

What I am inclined to interpret as males of *boreale,* so closely do they approximate the description of Robertson, are two specimens from Texas. One of these was obtained at Kingsville, July 30, 1921, by M. A. Cazier, the other at Plainview, July 16, 1932, by R. H. Painter. Cockerell's description of the male of *gilense* [Cockerell, 1900, Ann. Mag. Nat. Hist. (ser. 7) 5:413-414] is unfortunately very brief and does not offer clear-cut distinctions from the characters set down by Robertson for the male of *boreale.*

Evidently in *gilense, boreale,* and *robertsoni* we have three very closely related forms and the separation of these from *notatum* is only slightly greater. While *robertsoni* is primarily a Far Western form, it is by no means confined to the Pacific coast. Originally described from California, Cockerell expressed surprise when specimens came to his attention from Oregon and Utah [Cockerell, 1925, Proc. California Acad. Sci. (ser. 4) 14:362]. Yet its distribution far transcends these areas. A female obtained at Fallon, Nevada, by E. L. Bell on June 18, 1930 and a male captured by the same collector on July 24, 1934 in Indian Garden (elevation about 3800 feet) in the Grand

Canyon, Arizona, furnish evidence of the presence of *robertsoni* in two additional western states. Its presence in Colorado has also been confirmed (Schwarz, 1926, Amer. Mus. Novitates, no. 226, p. 17). *Anthidiellum robertsoni* has even crossed the international border. I have seen specimens from localities in the Mexican states of Chihuahua, Durango, and Coahuila that were collected by the American Museum Mexican expedition of 1947.

Throughout this large territory *robertsoni* varies comparatively little. Sometimes the male has maculations on the axillae as well as on the scutellum but more often only the scutellum is maculated. Now and then the glistening longitudinal carina on tergite 6 of the male is feebly developed to absent, grading into the condition represented by the male of *notatum*. The abdominal maculations are at times slightly variable in both sexes and the maculations of the female on tergite 6 are occasionally feeble or absent, recalling the condition in the female of *gilense*. This immaculate condition of tergite 6 is more especially encountered in certain of the specimens from Mexico. Notwithstanding these evidences of instability within series sometimes from the same locality, it is difficult to establish any trustworthy line of demarcation within this large territory unless it be in the case of *gilense*. Whether *gilense* itself may not tend to blend into *boreale*, notwithstanding the distinctions that have been noted between the females assigned to each, can only be determined when large series are available. As yet very few specimens of either form have been reported in the literature. Based on our present knowledge, the following key for the female of these closely related forms of *Anthidiellum* may be offered.

1. The lateral face marks extending to the level of the anterior ocellus 2
   The lateral face marks truncated at the level of the insertion of the antennae or extending only a little beyond, terminating well before the level of the anterior ocellus is reached 3
2. The maculations yellow, sometimes faintly tinged with ferruginous. Tergite 1 with a maculation at each lateral extremity, separated by a wide median area of black. (Eastern Seaboard) .....*notatum* Latreille
   The antennae (almost wholly), the facial, thoracic, and abdominal markings, as well as the joints of the legs below the trochanters, usually strongly red, but sometimes only the greater number of these maculations strongly red, others tending to orange. The band on tergite 1 usually continuous. (Florida) .....*rufimaculatum* Schwarz
3. The legs largely black, with a yellow stripe (usually not extending to the apex) on the outer face of the front tibiae, a yellow stripe extending from base to apex on the outer face of the middle tibiae, and a basal and sometimes an apical yellow maculation on the outer face of the hind tibiae. Clypeus immaculate. (Pacific Coast and Rocky Mountain states) .....*robertsoni* Cockerell
   Apex of femora and all the tibiae and tarsi apricot-colored with sometimes yellow 4
4. The clypeus wholly black. Tergite 6 with two yellow spots. (Midwestern) .....*boreale* Robertson
   The clypeus with a small yellow spot on each side. Tergite 6 immaculate. (New Mexico and Arizona) .....*gilense* Cockerell

NOTES ON THE GENUS *VELIA* (Hemiptera: Veliidae)

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The present paper describes a new species of the genus *Velia* Latreille from Venezuela, the allotype of *V. summersi* Drake from Arizona and raises *V. cognata* Drake and Harris from Brazil to the species level. The holotypes of all the above species are in the Drake Collection (U.S.N.M.).

Velia cognata Drake and Harris

Velia capitata cognata Drake and Harris, 1933, Proc. Biol. Soc. Wash. 46:45-46.

On account of its much larger size and antennal measurements, *V. cognata* is here raised to the specific level. The color, markings, hairy vestiture and shaggy appearance are rather similar in the two species. The antennal measurements of *cognata* are: I, 0.92 mm.; II, 0.80 mm.; III, 0.90 mm. and IV, 1.10 mm. Of *V. capitata*: I, 0.75 mm.; II, 0.40 mm.; III, 0.82 mm. and IV, 0.92 mm. *Cognata* is 5.50 mm. in length and *capitata* 4.20 mm. long.

Velia amoena, new sp.

MALE. Large, dark brown with humeral angles and posterior margin of pronotum rather broadly margined with testaceous. Appendages brown without pale markings, sometimes with superior surface of femora slightly darkened. Body beneath brownish without markings. Length, 7.60 mm.; width, 2.50 mm. (at humeral angles).

Head 1.35 mm. wide across eyes, with deeply impressed median longitudinal line and basal markings. Antennae 4.35 mm. long, slender, shortly pubescent, measurements—segment I, 1.30 mm.; II, 1.20 mm.; III, 0.86 mm.; IV, 1.00 mm. Labium brownish with last segment black, extending a little beyond prosternum. Eyes reddish fuscous. Pronotum 2.50 mm. long and 2.05 mm. wide at humeral angles, rather coarsely deeply punctate, nearly flat, with median longitudinal carina distinct anteriorly, humeri very little raised, shield-shaped behind. Legs moderately long, rather slender, shortly pubescent, without spines, concolorous, without color bands. Anterior legs with femur and tibia subequal in length (2.10 mm.); tarsi II shorter than III (25.38). Middle legs with femur 2.50 mm. long and tibia 2.75 mm.; tarsi II and III practically subequal in length (38:40). Hind legs with femur 3.00 mm. long and tibia 3.80 mm.; tarsal segment II distinctly longer than III (75.56).

Abdomen with connexival segments angulately extended posteriorly but not nearly attaining middle of first genital segment, beneath transversely convex, with last ventrite deeply broadly roundly excavated behind, without median carina or other structures on ventral surface; first genital segment above slightly convex, hairy, gradually rounded behind, nearly as wide as long, beneath flatly transversely impressed behind base. Parameres long, flat, convex on inner flat surface, with edges narrowed apically and tapering to a point. Suranal plate hooks flat, obliquely erect, with narrow inner

edges divergent upwards, thus with the flat surfaces in front and behind.

Female unknown.

Type (male), Venezuela, in Drake Collection (U. S. National Museum).

This species may be separated from *V. flavomarginatus* Hung. and other members of the group by the antennal measurements, shape of parameres and color markings.

Velia summersi Drake

Velia annulipes Kirkaldy and Torre-Bueno, 1909, Proc. Ent. Soc. Wash. 10(3-4):204. (Wrongly determined as *V. annulipes;* Arizona.)

Velia annulipes Van Duzee, 1917, Cat. Hemip. p. 437. (Wrongly named; Arizona.)

Velia summersi Drake, 1951, Rev. Ent. (Brasil) 22(1-3):371-372. (Described alate female from Arizona.)

APTEROUS MALE. Very stout, dark brown to dark fuscous-brown, without pale markings on body and antennae; legs with flavous markings. Length, 6.00 mm.; width, 2.25 mm.

Head with smooth, median, longitudinal line and usual basal impressions. Antennae 3.70 mm. long, very shortly pubescent with a few scattered longer hairs on last two segments, measurements—I, 1.56 mm.; II, 0.80 mm.; III, 0.98 mm.; IV, 0.80 mm. Pronotum 0.98 mm. long and 0.90 mm. wide (near base of hind lobe), punctate, with an encircling row of pits a little behind front margin, with a few larger pits between lobes, without median carina; hind lobe evenly broadly rounded behind, almost semiglobose; front lobe shorter, impressed on each side, with a small patch of longer silvery hairs in each impression. Abdomen broad, 4.00 mm. long and 1.80 mm. wide (near middle), constricted slightly behind base and then narrowed apically beyond middle, with a few tiny patches of silvery hairs; connexiva narrowed posteriorly on apical fourth. Penultimate segment (VI) strongly broadly flatly extended posteriorly just above the surface of and slightly behind the posterior margin of ultimate (VII), with apex somewhat sharply rounded; last venter with hind margin rather deeply gently widely excavated, without median notch.

First genital segment above moderately hairy, deeply impressed basally on each side of median ridge; beneath broadly flatly deeply transversely impressed on basal three-fourths so that the surface is obliquely vertical. Parameres of the same general form as in *V. avaradana* and *verana,* with the apical end of the upright shaft rounded and the subapical pointed projection a little larger; the basal tuft of long hairs pale and two-thirds as long as the shaft. Yellowish brown or testaceous markings of legs as in winged form of female, the annulations sometimes not very pronounced. Winged male unknown.

Apterous female broader and stouter than male, last tergite long; fifth and sixth ventrites slightly widely produced behind. Connexiva narrowed apically, not produced behind. Pronotum as in male.

Allotype (apterous male), northeast of White River, Ariz., July 8-11, 1940, by Gertsch and Hood, in American Museum of Natural History, New York City. Several apterous males and females and one winged female were also netted with the allotype. The type (winged female) was taken in Oak Creek Canyon, Arizona.

This species may be separated from *V. verana* Drake and Hottes and *V. avarandana* Drake and Hottes by its larger size, shape of parameres and posterior projection of sixth ventrite in the male. *V. annulipes* Champion (1898) has differently shaped parameres from all three of the above species.

RECIPROCAL THIEVING FOUND IN *POLISTES FEDWIGAE* DALLA TORRE (Hymenoptera, Vespidae)

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On May 20, 1956, two nests of *Polistes fedwigae* (A and B) were found on a bamboo fence at Shimojômura, in Shimoina, Nagano Pref., Central Japan. The nests were about 3.5 m. apart. Each was composed of about 15-16 cells containing larvae in growing stages. Five days later, a severe combat of two queens was observed on Nest A. After a considerable time of fighting, the intruder escaped and the nest owner began to inspect nervously the comb surface. The owner of B was absent at the time. In the evening of the same day, a thief was again found on A, and simultaneously, another thief also on B. In both nests, the owners were absent and each thief was eagerly engaged in her task of extracting and chewing the growing larvae. Meanwhile, the thief on A finished her work, took flight and returned directly to *Nest B*. It was the owner of B. Surprised by the arrival of the owner, the thief on B escaped and returned to her own nest, *Nest A*. Therefore, this was reciprocal thieving by the owners of two adjacent nests. Thereafter, both the nest-owners remained in their own nest, showing a marked excitation and sometimes an attempt to repair the damaged cells. Their behavior was, however, distinctly disorganized. About 6 days after the thieving, both owners abandoned their nests.

This year the social wasps of the district suffered severe injury owing to the delayed frost in late April. Due to the scarcity of caterpillars on which to rear the brood, the appearance of *Polistes* workers was retarded about 10 days compared with the mean appearance of about June 25, and the thieving of queens from other nests was often observed. It resulted sometimes in successful recovery, but usually in extinction or abandonment of the nest. The thieving is easy if the nest owner is absent but evokes a severe combat in the presence of the owner. Though usually the intruder is defeated and retreats, this is not always the case. In one nest of *P. fedwigae*, the combats were repeatedly observed during several days between the owner and one definite intruder. Finally, the owner was defeated after a short combat and escaped from the nest. The nest was completely damaged by the thief and abandoned several days later.

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A DESCRIPTION OF THE MALE OF *ARCHEMYOBIA INEXPECTATUS* JAMESON, TOGETHER WITH A NEW SPECIES OF *ARCHEMYOBIA* FROM A TRINIDAD WOOLLY OPOSSUM (Acarina, Myobiidae)[1]

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In the process of examining material collected by Dr. Thomas H. G. Aitken, Trinidad Regional Virus Laboratory, Port-of-Spain, Trinidad, a new species of myobiid mite, in the genus *Archemyobia,* was found which had been taken from an opossum.

Jameson (1955) described *Archemyobia inexpectatus* as a new genus and species from a female myobiid mite found on an opossum. In 1952 the male of this species was collected from an opossum at Camp Lejeune, North Carolina. These mites are herewith described.

The two species of *Archemyobia* may be separated by the following key:

A. Laterals I-II and submedians I-II equal in size. Ventral setae between coxae III and IV, foliate ..... *trinidadensis* n. sp.
A.A. Laterals I-II and submedians I-II not equal in size. Ventral setae between coxae III and IV, setaceous ..... *inexpectatus* Jameson

Archemyobia inexpectatus Jameson

MALE. Body length including gnathosoma 551 μ; body width between coxae III and IV, 362 μ.

Venter: (Fig. 2, Plate I). Anterior to coxae II are three pairs of setae; posterior to coxae II is one pair of lateral setae; anterior to coxae III are three pairs of setae; lateral pair shortest; between coxae III and IV are two diverging rows of four setae each, inner pair longest; even with coxae IV are three pairs of setae, inner pair longest. Terminal bristles on posterior end of body approximately 348 μ long.

Leg I with five segments and two strongly curved tarsal claws; at base of leg I is a lightly sclerotized tubercle; segment I with one seta; segment II with two setae, a lateral sclerotized tubercle and a small ventro-lateral tubercle not sclerotized; segment III with two setae, a lateral curved sclerotized tubercle on outside margin and three lateral sclerotized tubercles on inside margin, median one smallest; segment IV with three setae and a small ventro-lateral tubercle not sclerotized; segment V with three setae, two small lateral tubercles not sclerotized, as figured, and two strongly curved claws. Tarsus II with two claws (Fig. 7, Plate IV); tarsi III and IV with two claws, one very small (Fig. 8, Plate IV); chaetotaxy of ventral side of legs as figured. Chaetotaxy of dorsal side of leg I as figured (Fig. 1, Plate I).

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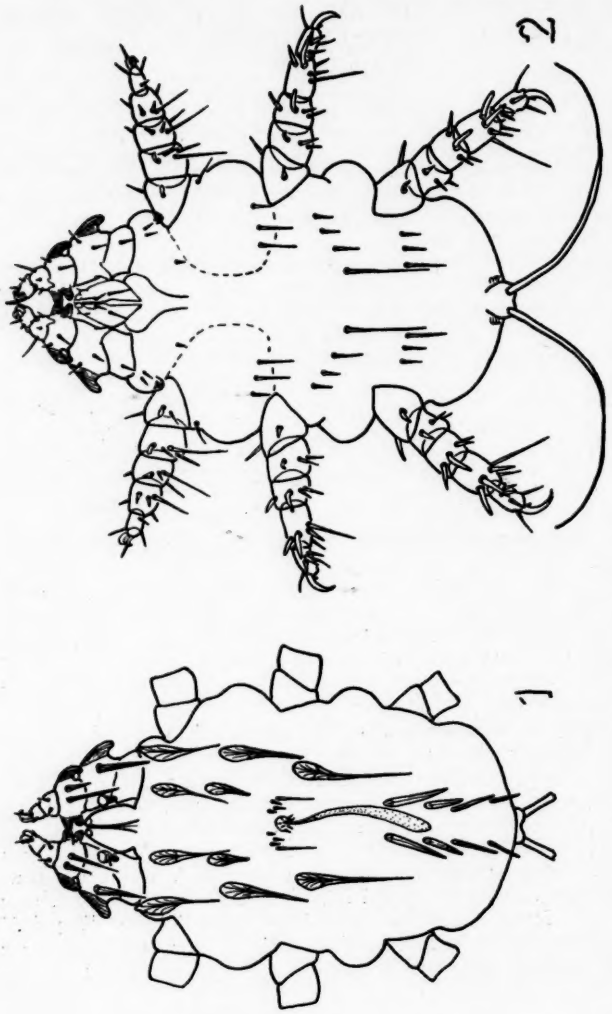


PLATE I
Archemyobia inexpectatus Jameson. Male: fig. 1, dorsum; fig. 2, venter.

Dorsum: (Fig. 1, Plate I). Lateral I-III and submedians I-II expanded and striated, striations running toward the midline of each seta. Lateral setae I originating between coxae I and II, extending to posterior margin of coxae II; lateral setae II originating at posterior margin of coxae II, extending to middle of coxae III; lateral setae III originating at middle coxae III, extending to posterior margin coxae IV. Submedian setae I originating anterior to coxae II, even with inside margin of coxae I, extending slightly past posterior margin of coxae II; submedian setae II originating even with posterior margin coxae II, extending to an area midway between coxae II and III; submedian setae III originating even with anterior margin of coxae IV, extending to an area posterior to coxae IV; submedian setae IV originating even with posterior margin of coxae IV, extending to an area midway between coxae IV and posterior margin of body; submedian setae V originating posterior to coxae IV as figured, extending to an area slightly anterior to posterior margin of body; submedian setae VI originating anterior to posterior margin of body, extending past posterior margin of body. Male genital opening posterior to submedian setae II as figured. Penis originating at the posterior margin of coxae IV between submedian setae IV, extending anteriorly at a slight curve to the genital opening as figured; four pairs of lateral setae near genital opening and two small pairs of setae on posterior margin of genital opening.

Host: *Didelphis virginiana* Kerr (Opossum).

Locality: Camp Lejeune, North Carolina, 12 June, 1952; collector T. Tibbetts.

Material: Allotype male deposited in the U. S. National Museum.

Remarks: Jameson in 1955 described a female *Archemyobia inexpectatus* collected at Patuxent Wildlife Research Refuge, Maryland; 14 January, 1950 by E. Ediger from an opossum. The allotype male and twelve female *Archemyobia inexpectatus* were collected at Camp Lejeune, North Carolina, 12 June, 1952 from an opossum.

Archemyobia trinidadensis n. sp.

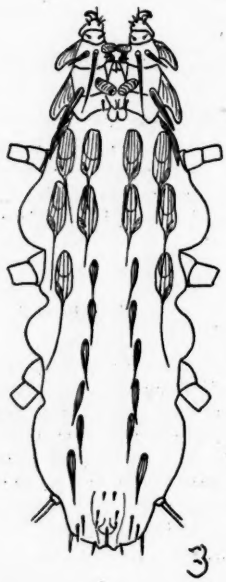
FEMALE. Body length including gnathosoma 638 μ and body width, between coxae III and IV, 232 μ.

Venter (Fig. 4, Plate II): Anterior to coxae II are three pairs of setae, anterior median pair longest; posterior to coxae II is one pair of lateral setae; anterior to coxae III are three pairs of setae, inner pair filiform and two outer pairs broadly foliate; even with posterior margin of coxae III are four pairs of foliate setae; even with coxae IV are three pairs of setae, posterior inner pair longest; one pair of setae on posterior margin of body flanking anal opening. Terminal bristles, 319 μ long, on lateral margin of opisthosomal region, 72 μ from posterior margin of body.

Leg I with five segments and two strongly curved tarsal claws; at base of leg I, on lateral margin of body, is a sclerotized tubercle; segment I with one seta; segment II with two setae, a lateral sclerotized tubercle and a small posterior tubercle not sclerotized; segment III with two setae, a lateral sclerotized tubercle on outside margin, three lateral sclerotized tubercles on

inside margin and a small posterior tubercle not sclerotized; segment IV with two setae and a small posterior tubercle not sclerotized; segment V with two setae, a small lateral and posterior tubercle not sclerotized and two strong claws. Tarsus II with two claws (Fig. 9, Plate IV); tarsi III and IV with paired unequal claws (Fig. 10, Plate IV); chaetotaxy of ventral side of legs as figured; chaetotaxy of dorsal side of leg I as figured (Fig. 3, Plate II).

Dorsum (Fig. 3, Plate II): Lateral setae I-III and submedian setae I-II expanded and striated, striations running parallel. Lateral setae I originating between coxae I and II, extending to an area slightly anterior to coxae III; lateral setae II originating close to posterior margin of coxae II, extending to posterior margin of coxae III; lateral setae III originating close to anterior margin of coxae III, extending to the middle of coxae IV. Submedian setae I originating even with lateral setae I, extending to an area midway between coxae II and III; submedian setae II originating even with lateral setae II, extending to middle of coxae III; submedian setae III originating near middle of coxae III, extending past posterior margin of coxae III; submedian setae IV originating even with posterior margin of coxae III, extending to anterior margin of coxae IV; submedian setae V



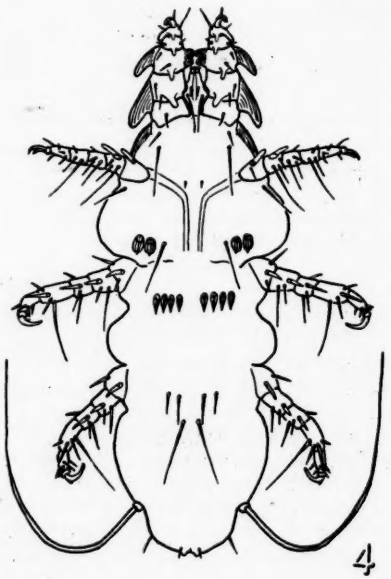


PLATE II

Archemyobia trinidadensis n. sp. Female: fig. 3, dorsum; fig. 4, venter.

originating anterior to coxae IV, extending to posterior margin of coxae IV; submedian setae VI originating anterior to posterior margin of coxae IV, extending past posterior margin of coxae IV; submedian setae VII originating past posterior margin of coxae IV, extending to an area anterior to terminal bristle; submedian setae VIII originating midway between coxae IV and terminal bristle, extending past terminal bristle. Two diverging rows of three setae each, lateral to genito-anal opening and four pairs of short setae flanking genito-anal opening as figured. Terminal bristle 333 μ long.

MALE. Body length including gnathosoma 435 μ and body width, between coxae III and IV, 166 μ.

Venter (Fig. 6, Plate III): Anterior to coxae II are three pairs of setae and a small tubercle that extends over anterior margin of coxae II, median pair of setae longest; posterior to coxae II is one pair of lateral setae; anterior to coxae III are three pairs of setae, inner pair filiform and two outer pair broadly foliate; even with posterior margin of coxae III are four pairs of foliate setae; even with coxae IV are three pairs of setae, inner pair longest; one terminal bristle on posterior end of body 334 μ long.

Leg I with five segments as in female, chaetotaxy of ventral side of legs as figured; chaetotaxy of dorsal side of leg I as figured (Fig. 5, Plate III).

Dorsum (Fig. 5, Plate III): Lateral setae I-III and submedian setae I-II expanded and striated, striations running parallel. Lateral setae I

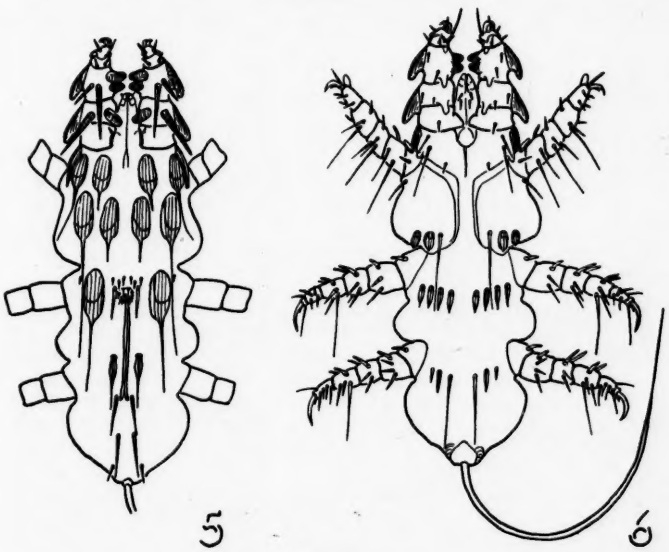


PLATE III
Archemyobia trinidadensis n. sp. Male: fig. 5, dorsum; fig. 6, venter.

originating between coxae I and II, extending to an area anterior to coxae III; lateral setae II originating even with coxae II, extending to anterior margin of coxae IV; lateral setae III originating even with coxae III, extending to posterior margin of coxae IV; lateral to lateral setae III is one pair of short setae. Submedian setae I originating even with lateral setae I, extending to posterior margin of coxae II; submedian setae II originating

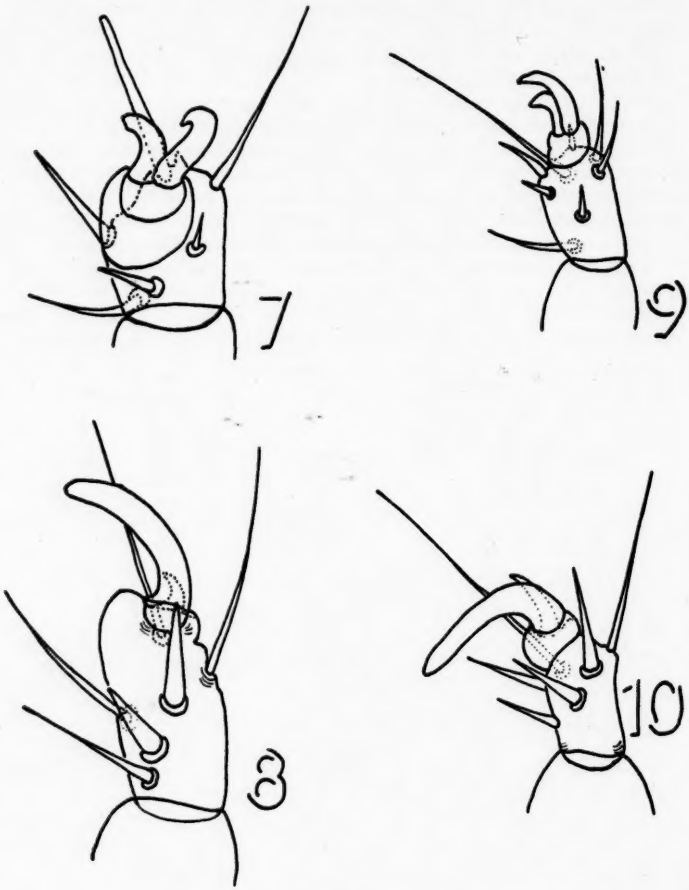


PLATE IV

Archemyobia inexpectatus Jameson. Fig. 7, tarsus II; fig. 8, tarsi III and IV. *Archemyobia trinidadensis* n. sp. Fig. 9, tarsus II; fig. 10, tarsi III and IV.

even with posterior margin of coxae II, extending to anterior margin of coxae III; submedian setae III originating even with anterior margin of coxae IV, extending past posterior margin of coxae IV; submedian setae IV originating even with posterior margin of coxae IV, extending past an area midway between coxae IV and posterior margin of body; submedian setae V originated even with an area midway between coxae IV and posterior margin of body, extending to posterior margin of body; submedian setae VI originating anterior to terminal bristle, extending past posterior margin of body. Genital opening between lateral setae III; penis originating even with submedian setae IV, extending straight anteriorly to genital opening as figured; seven pairs of small setae flanking genital opening as figured; posterior lateral pair longest.

Host: *Philander trinitatis* (Trinidad Woolly Opossum).

Locality: St. Patrick's Arima, Port-of-Spain, Trinidad, 25 July, 1953; Collector T. H. G. Aitken.

Material: Holotype female and allotype male on one slide deposited in the U. S. National Museum.

Remarks: These mites were studied under a phase contrast microscope. *Archemyobia trinidadensis* differs from *Archemyobia inexpectatus* in shape of body and ventral setae. In *Archemyobia trinidadensis* the two lateral pairs of setae anterior to coxae III and those between coxae III and IV are foliate. In *Archemyobia inexpectatus* these setae are not foliate.

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TRANSPORTATION BY APHIDS OF THE WHEAT CURL MITE, *ACERIA TULIPAE* (K.), A VECTOR OF THE WHEAT STREAK MOSAIC VIRUS[1,2]

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Slykhuis (1953) reported that *Aceria tulipae* (K.) (Eriophyidae) is a vector of wheat streak mosaic and later stated that the mite can be carried by the wind (Slykhuis and Andrews, 1953). This study was to investigate another means by which these mites may move from plant to plant.

Observations in the greenhouse showed that, when a wheat plant is heavily infested with *A. tulipae*, it soon becomes weakened and chlorotic. The mites then leave the curled and folded leaves and migrate upwards,

[1] Contribution No. 668, Department of Entomology, Kansas Agricultural Experiment Station, Manhattan. Investigations conducted cooperatively by the Department of Entomology and the Department of Botany and Plant Pathology.

[2] Minor portion of a dissertation presented as partial fulfillment of the requirements for the degree Doctor of Philosophy in Entomology at Kansas State College.

[3] Graduate Research Assistant and Entomologist, respectively.

forming "swarms" of fuzzy appearing, seething masses of thousands of individuals located on the uppermost tips of leaves or highest portions of the plant. Here the mites crawl upon one another, often forming chains of several individuals connected by their anal suckers; under greenhouse conditions many of these chains break apart from the mass and fall to the soil below. In the field, because of this exposed position on the plant, mites are readily air-borne, and undoubtedly this is the primary means of their dissemination.

Supporting evidence of mite dispersal by wind was indicated during the late spring of 1954, when a pot of wheat carrying swarming mites was observed in an open shed. Each gust of wind blew away a portion of the mites, and in less than 20 minutes there were no exposed mites left on the plant. The distance to which air-borne mites might be carried by the wind is still unknown. Pady (1955) caught several specimens, which were carried by a southerly wind, on greased slides located about 150 feet above the ground and 1½ to 2 miles north of the nearest wheat fields.

Observations on mite-infested plants with large aphid populations showed that winged aphids migrated to the highest plant parts before taking flight, a habit which often brought them directly into contact with the swarming mass of mites, indicating their possible role as a mite disseminator. The mites could be seen to crawl up the legs of the aphid and migrate over its body, including wings and antennae. Aphids reacted to these mites by scratching movements with their hind legs and by repeatedly folding and extending their wings, but the mites were rarely dislodged by such actions as a result of their firm attachment by means of anal suckers. However, mites were seen to depart from the aphid's body as readily as they had moved onto it. There appeared to be no taxes or purposefulness which caused them to move onto the aphid and remain there. When an aphid finally took flight, mites were usually still present on its body. Batchelor (1952) also observed eriophyids crawling on the legs and bodies of winged aphids and believed it "probable that these insects are in part responsible for their dispersion." *Aceria* was observed climbing on a leafhopper nymph on a plant of *Agropyron smithii* by Painter and Schesser (1954). Slykhuis (1955, p. 121) reported seeing *A. tulipae* clinging to thrips and unidentified aphids on wheat plants, but attempts to transmit mites by these insects were unsuccessful. However, he believed that a relationship between the mites and insects might exist.

The question which then arose was whether this "hitch-hiking" might be a means of mite dispersal in wheat fields, especially from ripening weed grasses to planted wheat or from ripening wheat to other hosts even though it probably would play only a minor role in the dissemination of mites. Also, field observations on newly sprouted wheat had shown on several occasions that, in a sample of 20 or more plants, only 1 was mite-infested, and this one would harbor 2 or 3 adult mites with no eggs present. Had these mites been air-borne by wind currents, a more general distribution would be expected, and it would appear improbable that a small group would land on 1 plant while nearby plants remained uninfested, unless the mites had travelled as a "chain" and had landed directly on 1 plant.

Greenhouse experiments were, therefore, initiated to determine the possibility of the transfer of eriophyid mites from infested to uninfested wheat plants by insects. Aphids were selected as a test insect because they are commonly found in the field in close association with *A. tulipae* on the wheat plant.

METHODS AND MATERIALS

All trials were conducted in 2 greenhouses. Space limitations determined the number of cages which could be used in each trial. In most of the tests, the only mites present in each particular greenhouse section were those on the host plants, i.e., plants which were purposefully infested with mites and aphids and served as a source of infestation. This eliminated the possibility of mite contamination from other nearby wheat plants.

Greenbugs [*Toxoptera graminum* (Rond.)] reared in the greenhouse on barley or wheat reproduced rapidly when transferred to the pots of mite-infested wheat. Corn leaf aphids [*Rhopalosiphum maidis* (Fitch.)] reared in the greenhouse on sorghum did poorly when transferred to wheat. English grain aphids [*Macrosiphum granarium* (Kby.)], corn leaf aphids, and greenbugs on green, mite-infested wheat heads found in another greenhouse section served as the source for host plants in Trial 9 (Table 1). The apple grain aphids [*Rhopalosiphum fitchii* (Sand.)] used in Trials 10 and 11 were also from a natural greenhouse infestation.

Wheat plants utilized were selection 462666 (Marquillo-Oro x Pawnee, C. I. No. 12851) which is highly susceptible to mite infestation.

Of the 11 trials (Table 1), 5 were conducted in lumite screen-covered field cages measuring $2' \times 2' \times 1\frac{1}{2}'$. Into one corner of each cage was placed a pot of wheat which was heavily infested with *A. tulipae* and aphids. Into the other 3 corners of each cage were placed 4-inch flower pots planted with mite- and aphid-free wheat. A control cage was identical but contained no aphids. The sides of all cages were covered with flannel outing to eliminate wind currents which might blow the mites from plant to plant. As a further guard against wind currents, each pot of host wheat was surrounded by either a large open-topped glass cylinder or a glass lantern chimney. The rims of flower pots were also smeared with tanglefoot to prevent mites from crawling to other pots of wheat. When aphids were seen on the seedlings in the 4-inch pots, the plants were pulled up and examined for mites.

In Trials 7 and 8, glass cylinders nearly 3 feet high were used to cage the host plants which were in the heading stage. A pot of uninfested seedlings was placed in another such cylinder, and the open tops of the two cylinders were then connected by a tube made of wire screen and cheese cloth to form an inverted U.

Trials 10 and 11 were made in the open greenhouse without the use of cages. In Trial 10, ten pots of old, weakened, mite- and apple grain aphid-infested wheat were grouped on a greenhouse bench and a 60-watt electric light was suspended several feet above. The light bulb was then covered by a glass lantern chimney with the outer surface coated with a mixture of vaseline and mineral oil. Aphids leaving the infested wheat plants were at-

tracted to the light and became entangled in the greasy mixture. These aphids were then removed in groups of two with a camel hair brush and washed in a small vial of carbon tetrachloride. The wash solution and aphids were then examined for the presence of mites. In Trial 11, several flats of plants which were heavily infested with mites and apple grain aphids were arranged on a greenhouse bench. Five pots of wheat were then planted and suspended overhead, several inches below the glass roof and at a distance of not less than 5 feet from the nearest flat. The aphids leaving the plants on the bench flew upward toward the light and soon infested the wheat seedlings. These seedlings were then examined for mites.

The procedure was varied frequently to determine the ability of the aphids to transmit mites under different situations.

RESULTS AND CONCLUSIONS

Results of the first 9 trials are summarized in Table 1. As stated previously, Trials 10 and 11 were conducted in the greenhouse using apple grain aphids, without the use of cages. In the tenth trial, one mite was found in close proximity to an entangled aphid, but there remained the possibility of this mite having been air-borne onto the location where it was found. In the eleventh trial, no mites were carried by the aphids to the seedlings.

Since mites were transported to the clean seedlings or other trapping device in seven out of the total of eleven trials and in 17 of 44 pots of plants, there is good evdience that aphids may serve as a means of transportation for these mites in the field. The distance over which the aphids transported mites in the greenhouse was limited only by the size of the cage since mites were transported to the furthermost pot of seedlings in each cage; the maximum distance was 5 feet. However, it has not been determined whether this was by a single direct flight, compared to an intermittent trip, nor has the length of time in transit been ascertained. Both of these could be important factors in the success of the transfer of mites in the field, especially in the case of long distances, because the mites apparently leave an aphid as readily as they climb onto the aphid's body.

Drafts on the test cages were eliminated as much as possible because of the likelihood of spreading mites by wind currents. In this artificial windless situation the aphids may not have moved as readily as they would have in the field where they may be carried long distances by the wind.

In one additional trial, the aphids which left the host plants became trapped in tanglefoot which had been applied to the upper rims of the glass cylinders as well as to the pot rims. In another additional trial the aphids did not leave the host plant. In these two trials none of the aphids reached the seedlings and, similarly, no mites were found on the seedlings.

The absence of mites on (1) seedlings in the two trials mentioned above; (2) on individual potted plants lacking aphids in other trials; and (3) on all of the control plants, was evidence that, under the conditions of the experiments, the mites could not reach the test seedlings without the aid of aphids. On only one occasion (Table 1, Trial 6, Cage 4) were mites found in a pot of seedlings on which no aphids were present. However, since

TABLE 1

Results of 16 greenhouse experiments to test the ability of various species of aphids to transport *Aceria tulipae* (K.) from infested to clean wheat seedlings, 1954-1956

Trial no.	Duration of trial (days)	Cage no.	Test insect	No. of pots of seedlings	Aphids moved over onto seedlings in pots[4]	Presence of mites on seedlings in pots[5]	Maximum distance mites carried (inches)[6]	Remarks
1	88	1	G.B.[1]	3	+++	++−	18	
2	85	1	G.B.	3	+++	+++	18	
3	51	1	C.L.A.[2]	3	+++	+++	18	Large No. of C.L.A. added to host. Host was viruliferous; seedlings became infected with mosaic.
4	24	1	G.B.	3	+++	−−−		
		2	G.B.	3	+++	−−−		
		3	G.B.	3	+++	−−−		
5	68	1	C.L.A.	3	+−−	−−−		Only one aphid moved onto seedlings.
6	61	1	C.L.A.&G.B.	5	+++++	−−−−−		Both species of aphids present in all pots of seedlings.
		2	C.L.A.&G.B.	3	+++	+−+	18	
		3	G.B.	2	++	++	18	
		4	G.B.	3	−+−	−++	18	Only case when seedling acquired mites but with no aphids present.
		5	G.B.	3	+−−	−−−		
		6	C.L.A.&G.B.	3	+++	−−−		Both species of aphids present in all pots of seedlings.
7	30	1	C.L.A.	1	+	+	12	Sorghum seedlings used.
8	25	1	C.L.A.	1	+	−		Only one cast aphid "skin" found.
9	35	1	C.L.A., G.B., E.G.A.[3]	2	++	++	60	Aphids from green, infested, cut wheat heads. All species moved to seedlings.
Totals	24 to 88 days	16 cages		44 pots	38+,6−	17+,27−	12to60	

[1] G.B.=Greenbug, *Toxoptera graminum* (Rond.). [2] C.L.A.=Corn leaf aphid, *Rhopalosiphum maidis* (Fitch.). [3] E.G.A.=English grain aphid, *Macrosiphum granarium* (Kby.). [4] + indicates aphids present in pot; — indicates aphids absent. [5] + indicates *A. tulipae* present in pot; — indicates *A. tulipae* absent. [6] In each case this is limit of cage size.

aphids were present on other seedlings in this cage, mites may have been deposited by aphids that visited but did not remain on the plants in this pot.

It is concluded that greenbugs and corn leaf aphids are capable of transporting living *A. tulipae* from infested to clean wheat plants. Apple grain aphids and English grain aphids may also be capable, but more evidence is needed to support the results secured with these species.

In the field it appears that transportation of the mites by aphids, although probably not responsible for large scale dissemination, may be a factor in placement of mites directly onto volunteer wheat or other grass hosts, especially if these hosts are scarce. It is possible that mites can be transported further with certainty and arrive on a host with greater frequency if carried by an aphid (or other insect) rather than by the wind.

SUMMARY

Observations in the greenhouse showed that wheat plants harboring large populations of the wheat curl mite, *Aceria tulipae* (K.), often become weakened and chlorotic. At this state, the mites swarm upward and form fuzzy masses of great numbers of individuals on the uppermost plant parts. Aphids were observed to move into these masses before taking flight with the result that mites crawled onto their bodies and wings. Since mites remained in place when the aphids flew away, it suggested that this might be a means of mite dispersal in the field.

In 16 experiments, a pot of mite- and aphid-infested wheat plants was placed in one corner of a cage and surrounded by pots of clean wheat seedlings in the other three corners. When aphids were seen on the seedlings, the plants were pulled up and examined for mites. Of 44 pots of clean seedlings exposed in nine separate trials, aphids moved onto wheat plants in 38 pots and carried mites onto the seedlings in seventeen instances. Greenbugs were the most successful in transporting the mites. Corn leaf aphids, English grain aphids, and apple grain aphids were also tested on a limited scale with positive results.

Mites were carried 5 feet, which was the greatest dimension of the largest cage used.

Although the transportation of mites by winged aphids, or other flying wheat field insects, may be only a minor means of mite dispersal, this form of transportation may be of significance in placement of the mites directly onto volunteer wheat or other suitable hosts. This would greatly increase the chances of survival of mites, especially at a time when volunteer or other suitable hosts are scarce.

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THE EFFECTS OF PIPERONYL BUTOXIDE ON THE MODE OF ACTION OF MALATHION IN COCKROACHES[1]

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Effects of piperonyl butoxide and other pyrethrum synergists on lethal actions of organic phosphorus compounds have been investigated by Eddy *et al.* (1954), Hoffman *et al.* (1954) and Rai *et al.* (1956). The latter workers observed a statistically significant level of antagonistic action when malathion was applied topically in cobination with piperonyl butoxide to individual house flies of either susceptible or DDT-resistant strains.

MATERIALS AND METHODS

The two species of one/two-week-old male cockroaches, *Blattella germanica* (L.) and *Leucopheae maderae* (F.), that were used in studies reported here were reared in a room maintained at 80±2°F. and provided with incandescent light continuously and had no previous history of insecticidal exposures. They were anaesthetized with a minimum of CO_2 to facilitate handling while sexing and treating. The temperature in the room where they were treated and maintained afterward for mortality observations was 80±5°F.

The compounds used were malathion[5] (99.6% pure) and technical grade piperonyl butoxide.[6] All the test solutions were made in glass-distilled acetone. Solutions of malathion and piperonyl butoxide were made at 1:10 ratio. Individual topical applications of 1.07±0.05 μl, containing the amounts of compounds indicated, were made on the mesosternum of the German cockroach using the microapplicator described by Roan and Meada (1953); whereas, to the Madera roaches, 5 microliters of the test solution from a 5λ micropipette was applied on the center of the abdominal tergite underneath the wings.

[1] Contribution No. 689, Department of Entomology, Kansas Agricultural Experiment Station, Manhattan. This study was supported in part by the office of the Surgeon General, Department of Army, under contract No. RA-49-007-MD-574.
[2] Part of a thesis presented in partial fulfillment of the requirements for the degree, Master of Science in Entomology from the Graduate School, Kansas State College, Manhattan.
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[6] U. S. Industrial Chemicals Company, New York, N. Y.

Six dosage levels of malathion, each alone and in combination with piperonyl butoxide, were tried on German cockroaches. Only four dosage levels of malathion and malathion plus piperonyl butoxide were employed on Madera roaches. For each insecticidal combination and dosage level, 20 cockroaches were used. Each test was replicated four times. In each test 10 cockroaches, treated with equivalent quantities of acetone, served as controls to correct for natural mortality (Abbott, 1925).

Treated cockroaches of each group were maintained in quart jars, which served as recovery jars. Each recovery jar was provided with a dog meal pellet suspended from copper wire through the perforated tight fitted screw cap. A small 5 cc. shell vial filled with water and plugged with cellucotton was suspended by another copper wire from the top to supply water. Periodical mortality counts were taken. Only the results of the 24-hour mortalities have been presented in the respective tables. Final mortalities were determined by teasing the cockroaches. The absence of any observable movement of the body, or any part thereof, was the criterion for declaring the cockroach dead.

TABLE 1

Percent mortalities of male German cockroaches, *Blatella germanica* L., and male Madera roaches, *Leucopheae maderae* F., at various dosage levels of malathion and malathion-piperonyl butoxide mixtures at the ratio of 1:10[a]

Dosages μg of malathion per roach	Percent Mortalities[b]	
	Malathion	Malathion + Piperonyl butoxide
	German cockroach	
2.14	82.0	95.0
1.61	78.7	92.2
1.07	66.0	83.0
0.54	50.0	66.0
0.32	38.0	40.0
0.21	30.0	25.0
	Madera roach	
100	88.0	68.0
75	68.0	52.0
60	62.0	38.0
50	50.0	30.0

[a] Sites of topical insecticidal solutions on German and Madera roaches were mesosternum and center of the abdominal tergites, respectively.

[b] Percent mortalities, corrected for control mortalities, are the average of four replications of 20 male roaches per dosage level.

RESULTS AND DISCUSSION

The percentage of mortality figures for German cockroaches at various dosage levels of malathion and malathion plus piperonyl butoxide are presented in Table 1. It appears that the presence of piperonyl butoxide synergises the lethal action of malathion in cockroaches since the percentage of mortalities of malathion-piperonyl butoxide were always higher, at all dosage levels, except one (0.21 μg/roach), than the values for malathion when used alone.

The percentage of mortalities of male Madera roaches at various dosage levels, Table 1, do not exhibit synergistic action between malathion-piperonyl butoxide combinations on this species of cockroach. At all the four dosage levels, the average percentage mortality figures were smaller for the malathion-piperonyl butoxide combinations than for the malathion alone. This suggests the possibility of an antagonistic type of lethal action between malathion and piperonyl butoxide mixtures.

To obtain a better picture of these results, LD_{50} values, obtained from log-dosage probit-mortality regression lines plot, are presented in Table 2. It is apparent that to obtain 50 percent mortality in the population of German cockroaches it takes less malathion per gram of body weight when it is applied in combination with piperonyl butoxide. In the case of Madera roach, if malathion is employed in combination with piperonyl butoxide, more malathion is required than when it is used alone.

TABLE 2

LD_{50} values[a] for malathion, alone and in combination with piperonyl butoxide (1:10 ratio) at 24 hours after treatment of German and Madera roaches by topical applications

Species of cockroaches	LD_{50} (μg of malathion/gram of body weight)	
	Malathion	Malathion + Piperonyl butoxide
German	89.40	67.10
Madera	271.60	521.30

[a] LD_{50} values were calculated from eye-fitted log-dosage-probit mortality regression lines.

At present, this species specificity of antagonism and/or synergism between malathion-piperonyl butoxide on two species of cockroaches is difficult to explain. The variation in the site of application alone does not appear to explain the differences of lethal action. Unpublished results from this laboratory have indicated that the antagonistic type of action between malathion-piperonyl butoxide on DDT-susceptible and resistant house flies was not affected with the variation in the site of application nor was there any appreciable change in the magnitude of antagonism.

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NYSIUS OF SOUTH DAKOTA (Lygaeidae—Hemiptera)

WILLIAM M. HANTSBARGER[1]

Nysius is a genus belonging to the subfamily Lygaeinae, tribe Orsillini.

Characteristics of the Subfamily Lygaeinae: Posterior margin of pronotum between scutellum and lateral angles more or less distinctly impressed or depressed; hemelytra, pronotum, scutellum and usually head, impunctate; two inner veins of membrane usually joined near base by a transverse vein (areola of membrane with two veins arising therefrom).

Characteristics of the Tribe Orsillini: Apical margin of the corium sinuate; apical angles of antennal tubercles prominent, acute or subacute; dorsal segment VI of male rounded; male genital segment foveate; scutellum near base with a more or less distinct transverse ridge, the base depressed anterior to ridge and longitudinally carinate posterior to it.

Characteristics of the Genus Nysius: Costal margins of hemelytra straight at base only, if at all; eyes not very prominent; bucculae variable; apex of ostioles suddenly abbreviated, rarely sub-auriculate; anterior femora unarmed.

Key to South Dakota Species

1. Bucculae quite short, never reaching beyond middle of gular region; rostral segment I extending much beyond bucculae, reaching nearly to base of head. Length from 4.7 to 5.6 mm. ..... *californicus*
   Bucculae much longer, always extending beyond middle of gular region, often approximately same length as first rostral segment. Length variable, usually ranging from 3.1 to 5.0 mm. 2
2. Bucculae high in front, slightly narrowing posteriorly, ending abruptly at base of head. Length 4.25 to 4.50 mm. ..... *angustatus*
   Bucculae low, gradually fading out to end at point before base of head 3
3. Pronotum short, nearly twice as wide as long and subequal to length of head, costal margins of corium usually sub-parallel to each other ..... *raphanus*
   Pronotum longer, much less than twice as wide as long and usually a little longer than head; costal margins of corium not parallel to each other ..... *ericae*

Nysius californicus Stål

This species is the largest that occurs in South Dakota. It can be readily distinguished from other species because of its larger size and much shorter bucculae (Plate I, fig. 1).

The first recorded specimen is from Ft. Pierre, Stanley County, September 21, 1920. Since that time *N. californicus* has been found throughout the state in the following counties: Harding, Butte, Lawrence, Pennington, Custer, Ziebach, Haakon, Jones, Jackson, Bennett, Gregory, Sully, Hughes, Hyde, Buffalo, Brule, Brown, Beadle, Day, Kingsbury, Brookings, Bon Homme, Lincoln, Clay and Union.

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N. californicus was regarded by Barber (1947) as a species occurring in western Canada and western United States. Torre-Bueno states that it is apparently distributed all over the United States.

Nysius angustatus Uhler

This species can be distinguished from other South Dakota species by the shape of the bucculae which are high in front and end abruptly at the base of the head (Plate I, fig. 3).

The first recorded specimen is from Lake Hendricks, Brookings County, July 12, 1922. Since that time *N. angustatus* has been found in Harding, Butte, Lawrence, Pennington, Custer, Fall River, Perkins, Meade, Haakon, Hyde, Brown, Roberts, Deuel and Lincoln Counties. Its distribution is rather spotted throughout the state.

Torre-Bueno (1946) considered *angustatus* to be a synonym of *ericae* which he described as occurring throughout the United States. Barber has restored *angustatus* as a distinct species. He mentions that it is distributed over all Canada and the northern United States with the southern limits being in Kansas.

PLATE I

Figure 1. Lateral view of head, showing buccula of *N. californicus*. Figure 2. Lateral view of head, showing buccula type of *N. raphanus* and *N. ericae*. Figure 3. Lateral view of head, showing buccula of *N. angustatus*.

Nysius raphanus Howard

This species closely resembles *ericae* but can be distinguished from the latter by the short pronotum which is nearly twice as wide as long and the costal margins of the corium which are nearly parallel. The average specimens of *raphanus* also tend to be smaller than *ericae*.

The first recorded specimen is from Capa, Jones County, June 11, 1921. *N. raphanus* appears to be rare in the state. Since the first record it has been found only in Harding, Lawrence, Perkins, Jackson, Hughes, Roberts and Brookings Counties.

N. raphanus is regarded by Torre-Bueno to be a synonym of *ericae*. Barber regards *raphanus* as a distinct species. He indicates that it is a more southern species but in some areas may overlap with *ericae*. This happens in South Dakota, where the rarity of *raphanus* may indicate that the state lies in its most northerly range.

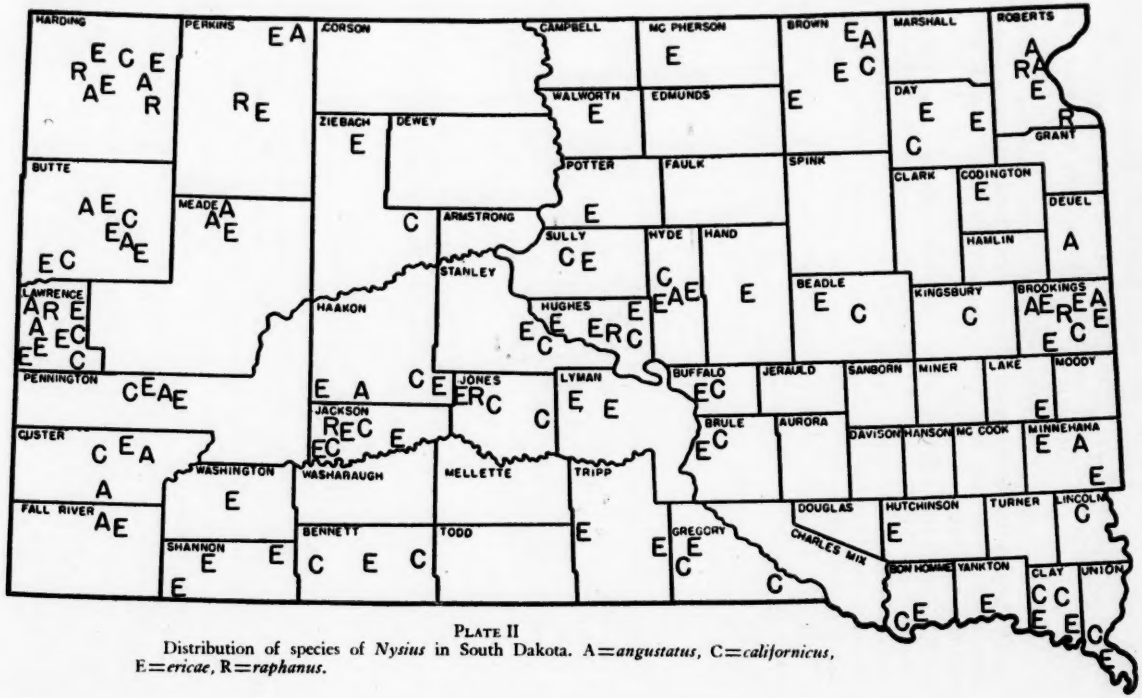

PLATE II
Distribution of species of *Nysius* in South Dakota. A=*angustatus*, C=*californicus*, E=*ericae*, R=*raphanus*.

Nysius ericae (Schilling)

This species is distinguished from *raphanus* by the longer pronotum (less than twice as wide as long) and by the fact that the costal margins of the corium are more sinuate. *N. ericae* also tends to average larger in size.

The first recorded specimen is from Brookings, Brookings County, June 11, 1891. Since that time it has been found in Harding, Butte, Lawrence, Pennington, Custer, Fall River, Perkins, Meade, Shannon, Bennett, McPherson, Walworth, Potter, Sully, Hughes, Hyde, Hand, Buffalo, Brule, Brown, Beadle, Hutchinson, Bon Homme, Yankton, Clay, Union, Minnehaha, Lake, Codington, Day and Roberts Counties. This species is the one most commonly encountered in South Dakota, and the one with the largest distribution. Barber states that *N. ericae* is a holarctic species and occurs in the entire dominion of Canada and all across the northern United States. Its southern limits are given as Kansas. Torre-Bueno gives the distribution of *ericae* as all over the United States and Canada.

N. ericae is the only species of economic importance in South Dakota. It feeds on a wide range of host plants, at times becoming injurious to various field and garden crops.

ACKNOWLEDGMENTS

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